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INTERNATIONAL RICE COMMISSION

NEWS LETTER

Issued by the I.R.C. Secretariat, c/o FAO Regional Office, Bangkok, Thailand.

No. 12 *December, 1954*

SUMMARY OF RECOMMENDATIONS OF THE FOURTH SESSION OF THE INTERNATIONAL RICE COMMISSION

HELD IN TOKYO, JAPAN, 11 – 19 OCTOBER, 1954

THE Fourth Session of the International Rice Commission, convened by the Food and Agriculture Organization of the United Nations, and held by invitation of the Government of Japan at Tokyo, 11 – 19 October, 1954, was attended by 92 participants representing 21 Member Governments and 3 international organizations. Prior to this, the meetings of its two Working Parties – Working Party on Rice Breeding and Working Party on Fertilizers – were held simultaneously from 4 to 10 October, 1954, also at Tokyo by invitation of the Government of Japan.

At the Fourth Session of the Commission the following recommendations were adopted:

Concerning Reports of the Fourth and Fifth Meetings of the Working Party on Rice Breeding.

(1) The Commission, after considering the reports of the Fourth and Fifth Meetings of the Working Party on Rice Breeding, expressed its appreciation for the work carried out by the Working Party, indicated its agreement with the conclusions and recommendations, and emphasized the following points arising out of these recommendations: (a) the need for additional contributions from Governments to ensure successful completion of the rice hybridization scheme; (b) the need for special attention by Governments to the phases of the rice hybridization project being continued in their respective countries in

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order to ensure satisfactory completion; (c) the importance of special attention to the maintenance of genetic stocks in countries which had agreed to provide facilities for this purpose; (d) the need for continuing and increasing attention by Governments to seed production and distribution schemes; and (e) the need for more adequate training facilities for technical workers within countries. The plan of FAO to hold a further international training center on rice breeding in 1955 in accord with an earlier request of the Working Party, was also noted with approval and appreciation.

Concerning Reports of the Third and Fourth Meetings of the Working Party on Fertilizers

(2) The Commission, having considered the reports of the Third and Fourth Meetings of the Working Party on Fertilizers, commended the Working Party for the work it had accomplished, indicated its agreement with the recommendations of the Working Party, and emphasized in particular the importance of conducting geo–morphological and ecological investigations in countries as a basis for planning the most efficient use of fertilizers. Note was also taken, with appreciation, of the plan of FAO to hold a further international training center on fertilizers for rice in 1955, in accord with an earlier request of the Working Party.

(3) The Commission also drew the attention of Governments to the importance of using factorial designs in the conduct of agronomic research, and to the desirability of including in such research projects as wide a range of variables as possible.

Concerning Soil–Water–Plant Relationships:

(4) The Commission, after considering the subject of soil–water–plant relationships which had been considered jointly by the Working Parties on Rice Breeding and on Fertilizers, recommended that the Director–General of FAO should invite Governments of perhaps five to seven countries in which substantial work is under way to designate workers who could participate in an *ad hoc* working group to undertake detailed consideration of this problem. It further agreed that the report of this working group should form the basis for consideration of the problem in the joint meetings of the Working Parties on Rice Breeding and on Fertilizers in 1955 and 1956, and in the Fifth Session of the Commission, at which time possible further steps would be decided.

Concerning Problems of Mechanization of Rice Production:

(5) The Commission, after considering the working papers before it and the statements of delegates relating to equipment for lifting water for irrigation, hand and animal operated machinery and powered equipment for tilling and harvesting, recommended that the Director–General of FAO should invite from five to seven Member Governments to designate representatives to an *ad hoc* group which would study and evaluate problems of mechanizing rice production techniques as they apply to machines and implements and their use under conditions in the countries of Asia and the Far East. The Commission further agreed that the findings of this *ad hoc* group should be presented to the Fifth Session as

a basis for discussion and for determination of future steps to be taken with regard to mechanization.

(6) The Commission recommended the continuing cooperation of Governments with FAO in the supplying of information on devices for lifting water, in order that a paper on this subject which is now in preparation may be completed.

(7) The Commission, having considered the importance of careful analyses of the cost of introducing and maintaining mechanized farming, recommended that Governments give careful attention to the desirability of undertaking studies on devices used for lifting water in their countries and determining the comparative costs of installation and operation of these devices, and also that Governments consider the desirability of selecting representative areas for determining labour and power requirements, distribution of labour, need for mechanization of certain farm operations and the cost of operating different types of equipment and power in the production of rice.

Concerning Reducing Losses in Rice through Improved Operational Methods:

(8) The Commission, having considered problems related to grading, drying, storage, milling and parboiling of rice, emphasized the great importance of this group of subjects to the Member Countries of the Commission and recommended to the Director–General the establishment of an *ad hoc* group to look carefully into the various technical aspects of processing and storage of rice and also its nutritional aspects, with the understanding that the report of the findings of this group would be presented to the Fifth Session of the Commission, both as a basis for discussion, and as a basis for determining future action in this field.

(9) The Commission considered that a training center or training centers on some aspects of storage and processing might be very useful to Member Countries, but owing to the complexity of the problems involved, recommended that the *ad hoc* group referred to under (8) above, should examine these questions, advise upon the desirability of holding such a training center or training centers, and if necessary, advise on the types of training to be included.

(10) The Commission, having considered briefly the problem of mildewed rice, recommended that the Director–General of FAO seek ways of fostering a proper scientific investigation of the problem and that Governments should carry out their own investigations in order that the matter might be examined more fully at the Fifth Session of the Commission.

(11) The Commission, having considered the nutritional aspects of rice storage and processing, recorded its deep interest in this subject and requested that the Fifth Session be informed of any important developments, either in Member Countries, or as a result of work in the FAO Nutrition Committee for South and South East Asia.

Concerning Use of Rice Fields for Fish Culture:

(12) The Commission, having considered this subject and its importance as a supplement to rice production in many countries, recommended that Member

Countries, be advised of the desirability of formulating research programs to obtain basic data on various aspects of fish culture in rice fields, and that any new technical information arising out of the consideration of this problem by the Indo–Pacific Fisheries Council be made available to the Commission.

Concerning Amendments of the Constitution of the International Rice Commission:

(13) The Commission adopted certain of the proposals which were before it for amendments to its Constitution and these amendments will become effective after concurrence by the FAO Conference.

Concerning the Time and Place of the Fifth Session

(14) The Commission received with appreciation, an invitation from the Government of India to hold its Fifth Session in that country in 1956, and recommended that the Director–General make arrangements with the Government of India for holding the Session in India sometime during the last three months of 1956.

(15) The Commission also heard with appreciation that while the Government of Ceylon desired to have the Fifth Session in Ceylon, the Delegate from Ceylon had agreed to its being held in India, in view of that country's prior invitation. However, the Delegate from Ceylon requested that his Government's interest in having the Sixth Session in Ceylon be kept in mind when the venue of that Session is considered.

(16) While considering the time and place of its Fifth Session, the Commission indicated its agreement to the proposals of the Working Parties on Rice Breeding and on Fertilizers, that their 1955 Meetings should be held in Malaya, and their 1956 Meetings at the same place as, and just prior to, the Fifth Session of the Commission.

Concerning Preparations for the Fifth and Other Future Sessions:

(17) The Commission noted the importance of adequate preparations by each Member Country for its participation in a Session of the Commission and recommended to Governments that they consider the establishment of preparatory groups, representing the various interests concerned with rice, which would undertake the preparation of material for presentation to each Session.

SUMMARY OF RECOMMENDATIONS OF THE FIFTH MEETING OF THE WORKING PARTY ON RICE BREEDING

HELD IN TOKYO, JAPAN, 4–10 OCTOBER 1954

The Fifth Meeting of the Working Party on Rice Breeding was attended by 46 participants representing 15 Member Governments and 3 international organizations and the following recommendations were adopted:

1. that in order to retain and permit recognition of selections capable of responding to heavy dressings of fertilizers, material derived from the international rice hybridization project involving *indica* and *japonica* types should be grown under high soil fertility conditions from the F_2 generation onwards;

2. that investigations on photoperiod response be discontinued on a cooperative basis, but that countries should individually continue studies of immediate practical value as well as such fundamental investigations in this field as are possible, in accordance with their interests and available facilities, giving greater attention to temperature and if possible installing equipment for temperature control;

3. that Member Governments make provision for intensification of studies of the physiology of the rice plant, which in view of the particular cultural conditions under which the crop is grown are urgently required;

4. that countries participating in the cooperative investigations on resistance to lodging should carry out the experiment designed at the 1953 meeting and that a full review of the results of investigations carried out since the inception of the project should be presented at the next meeting for consideration;

5. that FAO collect all available information on parasites of rice pests for submission to the next meeting of the Working Party with a view to formulating a cooperative project if found suitable;

6. that all available information on breeding for resistance to blast *(Piricularia oryzae Cav.)* be collected through correspondence and embodied in a working paper for consideration by the Working Party at its next meeting, with a view to formulating plans for cooperative investigations on this disease,

7. that all available information on methods of estimating losses due to pests and diseases of rice be assembled in a working paper for consideration by the Working Party at a future meeting;

8. that a working paper summarizing the present position with regard to studies of the inheritance of yield components be prepared, with suggestions for further investigations that might be organized on a cooperative basis, for consideration by the Working Party at its next meeting;

9. that a working paper on linkage groups in rice be prepared for consideration by the Working Party at its next meeting with a view to formulating means of accelerating advances in this field

of study through coordination of investigations;

10. that, with a view to acquiring information on the regional adaptability of rice varieties and the ecology of rice in order to ensure the most practical application of the results of rice breeding, introduction and seed distribution programs, plans for regional co-operative variety trials be formulated for consideration by the Working Party at its next meeting; and

11. that in view of the importance of seed projects in increasing rice production, officially operated seed schemes should not be regarded as business propositions, but that any losses arising through a sudden fall in prices should be borne by the responsible government agency.

SUMMARY OF RECOMMENDATIONS OF THE FOURTH MEETING OF THE WORKING PARTY ON FERTILIZERS

HELD IN TOKYO, JAPAN, 4–10 OCTOBER 1954

The Fourth Meeting of the Working Party on Fertilizers was attended by 33 participants representing 15 Member Governments and 1 international organization, and it was recommended that:

1. the Working Party on Fertilizers should continue to collate and summarise the basic data on the response of paddy to different amounts and kinds of fertilizers, the data to be compiled in a form that may be readily utilized by governments in developing policy on the production, importation, pricing and use of fertilizers;

2. in order to achieve the objective in recommendation (1) above, Member Countries that have not yet appointed liaison officers to report to the Working Party on Fertilizers should be requested to do so;

3. it is desirable that Member Countries should carry out analytical studies on paddy soils of known high and low productivity in order to advance further the project of correlating analytical characteristics with field response to fertilizer application. The Working Party further recommended that when relationships have been established soil samples should be forwarded for examination under uniform conditions at a central laboratory. This would permit comparison on a uniform basis, of paddy soils representative of the various rice-producing countries and of a range of productivity and fertilizer response levels;

4. each Member Government regard the classification and mapping of

paddy land on a geo–morphological and ecological basis as a desirable adjunct to research. Such a classification should lead to more effective experimentation and application of results. Further, that complete randomization be aimed at in the siting of agronomic experiments within each such region;

5. the International Rice Commission should draw the attention of Member Governments to the efficiency of modern factorial designs for the conduct of agronomic research and to the value of including where appropriate, as wide a range of variables as possible.

6. in order to promote the greater use of fertilizers and the adoption of other improved practices established by research and proved on cultivators' fields in countries where rice yields are low, the attention of Member Governments should be drawn to the importance of such measures as the provision of facilities to cultivators for the purchase of fertilizers, manures, machinery, etc. at reasonable rates or on short term credit and for educational purposes, the use of audio–visual aids, etc.; and

7. the effect of crop rotation on the growth and yield of paddy be selected for comprehensive review and discussion at the next meeting of the Working Party.

SUMMARY OF RECOMMENDATIONS OF THE JOINT SESSION OF THE TWO WORKING PARTIES

At the joint session of the Working Parties on Fertilizers and on Rice Breeding it was recommended that:

1. the International Rice Commission postpone further action on the proposal that governments undertake cooperative research on soil, water and plant relationships in the production of rice until such time as the nature of possible cooperative effort can more clearly be defined, bring to the attention of governments the urgent need for them to prosecute further research on those phases of the subject which are of immediate concern to their respective countries, and together with its Working Parties keep the subject under active review;

2. physiological diseases of rice be retained on the list of joint cooperative projects, that the progress and results of research on this subject in all countries concerned be embodied in an information paper for presentation at the next meeting, and that consideration of co–ordinated research be deferred until such time as sufficient progress has been made to provide a suitable basis for such a project; and

3. investigations on the interaction between varieties and fertilizer response be continued by countries on a cooperative basis.

THE IMPORTANCE OF IMPLEMENTS IN RICE PRODUCTION

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Rice as the principal or only cereal in the diet of a very large proportion of people in the world has come in for increased attention recently. This interest has been spurred by the world shortage of food, a shortage most acute in the parts of the world occupied by mainly rice eaters. The Food and Agriculture Organization of the United Nations has set up a special "International Rice Commission" the Executive Secretary of which is stationed at the FAO Regional Office in Bangkok, Thailand. This Commission has set up two working parties and has also started the publication of a News Letter on the subjects dealing with increasing rice production. In the first 9 issues of this bulletin a total of 50 articles are listed. Of these 50 articles, the titles of 3 only indicate that they deal with items of implements or implements procedures. One describes a water lifting device and 2 deal with aspects of mechanization of rice production. The provisional agenda for the fourth session of the Commission has one item with 3 sub–heads dealing with implements and mechanical equipment for dealing with the production of the rice crop. So far as is known, the Commission has not had anyone specially qualified in the field of agricultural engineering of farm implements to attend its previous meetings.

Surely this does not indicate a true estimate of the importance of tools and implements in rice production or of the relative importance of hand and animal powered implements as compared with mechanised equipment. With the millions of acres of rice now grown, the infinitesimal fraction of one percent of this area now mechanised or likely to be mechanised in the foreseeable future in Eastern countries, and with the enormous amount of human and animal labour now expended on the cultivation of rice, it would seem urgent that more attention be paid to the equipment problems of the rice farmer. There would seem to be urgent need for study of the incidence of labour on the various factors of rice production, for a study of what implements of an improved nature could be introduced to reduce the enormous amount of human labour required. This study needs to be conducted with the background in mind that rice is, with few exceptions, now produced on small holdings in small fields, mostly on bench terraces which cannot in most cases be levelled into large fields for mechanised equipment. Equipment recommended should fit into this pattern, with of course the ability to fit into use in larger fields being a desirable feature.

The author cannot claim to be a specialist on rice culture or on rice production equipment, though he has spent more than 30 years in a rice growing country. His service has been in an area where wheat is the predominant cereal crop with millets,

sorghums and pulses being of importance also. He has given some attention to rice problems however and it is hoped that the following analysis of the problems will at least serve to focus attention on the problems and to suggest lines of investigation. Most of what will be said is not new; its value, if any, will lie in the arrangement of the material and in the questions raised.

Although rice is grown under very varied conditions, most people think of rice cultivation as involving preparation of the fields by puddling under water and the transplanting of previously grown seedlings by hand into the puddled soil. Little attention is paid in the literature on rice to the fact that rice can be planted directly and that with proper methods the yields can be "as good as or even better than from a transplanted crop and the additional advantages are the saving in labour and water use". * Even when it is recognised that rice can be planted directly, often the only method considered is broadcasting, either on the dry land before flooding or on a shallow layer of water after puddling.

I would like to advance the theory that rice growing methods have been determined in the past primarily by the implements available and not by the requirements of the rice plant. I would further like to suggest that, there is a tie-up between variety and method under which it has been forced to grow and not something inherent in the variety otherwise. If this is true, it seems logical that a similar adaptation can be made to other procedures. This is confirmed by the quotation from Ramiah above and by other unpublished information in the possession of the writer.

The tillage operations connected with the growing of rice may be divided into three phases; (1) the pre-puddling operations, (2) puddling where transplanting is practised, and (3) inter-culture, weeding or, in Japan at least, some earthing up. A fourth might be introduced, the seeding when direct planting is practised.

A very wide range of operations seems to be done in various places in the pre-puddling stage. In some cases, ploughing is done immediately after harvest, in others later or not at all. A secondary crop, usually a pulse, or a green manuring crop may be grown if moisture and temperature permit. Usually no great effort is made to pulverise the dry soil, though harrowing may be done if there is sufficient moisture. Where direct planting is done, the most common procedure in India is broadcasting the seed on dry soil before the monsoon rains start. In many cases, it is stated that the soil is too dry and hard to do any operation before the rains start or without irrigation. Observation supports the opinion that in practically all conditions, there is sufficient moisture to do good ploughing immediately after harvest and this should be done. If a pulse or a green manuring crop is to be grown without irrigation and where moisture is deficient, probably some light scarifying operation should be done rather than ploughing with a soil inverting plough. For this a disk

* *K. Ramiah, "Japanese Method of Rice Cultivation in India", IRC News Letter, December 1953, page 19.*

harrow is probable the ideal tool so far as effect on the soil is concerned. If it is not available or cannot be used, probably some type of cultivator with narrow shovels offers the next best tool, with the blade harrow (known in India as a *Bakkhar* or *gantaka*) being a possible alternative choice. With the possible exception of the areas growing "deep water" or "floating" rice, it is believed that proper choice of time and implement will make possible at least one and possibly several operations between the harvest of one crop and the beginning of the planting season of another. Experience at Allahabad would indicate that these operations can all be done with steel animal–drawn implements.

For transplanted rice, the procedure involves puddling, with or without the handling of a green manure crop. Where the green manure crop is grown directly in the field it is usually ploughed under with a soil inverting plough. When it is grown outside the field and carried in and trampled into the soil during the puddling operation this causes special equipment problems. If the green manure is finely divided, it may be possible to plough it under with inverting ploughs; more commonly it is coarse material and must be trampled in by animals, by people or by some form of trampler, of which several have been developed. Where the complication of green manuring is not involved in the puddling operation, a variety of implements can be used. Probably a medium or small soil inverting plough is the most commonly used "improved" implement. In India the wooden plough of course is still widely used but is inefficient in the use of man and animal power. Cultivators have been little used but offer promise where there is limited grass or weeds to deal with. Quite possibly their utility can be greatly increased by the design of special shovels. This needs to be investigated as the puddling operation is one of the time and labour consuming operations. It is believed that the most important reason for puddling is not the preparation of the soil for receiving the plants but the killing of the weeds. Continuous growing of a single crop year after year on the same field tends to build up a population of weeds which also adapt themselves to the same conditions. If this cycle can be broken by preparing the field earlier, or by controlling the water at the beginning of the season till the weeds have germinated and been killed by other methods, there is reason to believe that there will be no additional benefit from the puddling operation.

I am satisfied that the subject of equipment for rice cultivation is important and that it deserves more attention than it is getting. I am conscious of my ignorance of the subject and would greatly appreciate correspondence with anyone interested and able to supply information. I hope to do some development work on rice culture implements and would like to have the advantage of all available information. I would appreciate references to existing literature on the subject, copies of reprints, opinions or comments on my opinions or on any phase of the subject.

PROVISIONAL CLASSIFICATION OF PADI SOILS IN MALAYA

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Almost all wet land padi in Malaya is grown on alluvial soils, there being very little of the hill slope terracing for irrigated padi such as is typical of parts of Java; thus alluvial soils are the only ones with which we need concern ourselves.

2. The factors which have the greatest influence on these alluvial soils, which are comparatively young and have thus very immature profiles, are the types of the parent material from which the alluvium is derived and the conditions under which it is laid down.

3. The alluvium in Malaya can be divided into two very broad types—that which has a covering of peat to varying thickness and that which has none, the peat either having disappeared or never been formed.

4. Peaty soils usually make poor padi soils, but the term "peat" is often loosely used for organic clays, and the percentage of organic matter content should always be quoted in referring to peaty soils.

5. Generally speaking, an original depth of 3 feet or less of wet swamp peat can be used for padi cultivation, as this depth of wet peat will shrink very little on opening up and draining of the land.

6. Deeper peat is practically useless for padi and the soil surveys now in progress on potential padi growing areas take this into account.

7. Alluvial soils can be divided into 3 groups based on their methods of deposition. The first group is the alluvial soils developed under marine conditions and on which former vegetation has often been mangrove. These soils form a very considerable part of the padi soils of the west coast which are generally quite high yielding. Their general characteristics are high clay and silt content, poor drainage and aeration which give them the typical bluish or blue grey colour of reduced soils. There are local variations. In the north of Kedah where there is a pronounced dry season, substantial cracking takes place to a depth of 2 feet or more and along these cracks can be seen much brown deposit of iron (ferric oxide). Further South, where the dry season is generally not so prolonged or marked, the same amount of cracking does not take place.

8. Due to the fact that they were laid down under marine conditions, these soils may on occasion contain toxic amounts of sulphides and on drainage become very acid. Examination of potential padi areas always includes investigations of this possibility.

9. The second group includes those soils deposited on the flood plains of the large rivers of which the most important area is the Kelantan Plain. The most striking difference of these soils from the alluvial soil seen on the west coast is that the

predominant colour is brown or reddish brown in contrast to bluish or greyish colour of the alluvium of the west coast. This colour extends right down the soil profile. The soil is more sandy and freer draining. At depth there are sometimes considerable quantities of mica and this arises from the granites of the hinterland.

10. The third group included those soils formed in the smaller inland valleys. In Negril Sembilan there are many of these small valleys and texturally the soil may vary very considerably within short distances. Often there may be a lot of very coarse gravels derived from the quartz in the granite, and these may occur in isolated patches. A mixture of these types of formation may occur.

11. Apart from this broad general classification, no attempt has been made to classify the padi soils in greater detail. It is known that one of the most important characteristics is the texture of the soil and textural analyses are carried out on all padi soil samples.

Soil Types and Manurial Response

12. Work on the classification of Malayan padi soils has not proceeded nearly far enough to tie up manurial response with soil type. However, the type of response can be stated in very general terms. The western marine alluvial soils are variable in response. In some areas no response to any fertilizer is obtained. In the north of Kedah there is a response to phosphates and nitrogen, and further south there have also been indications of responses to nitrogen. The eastern river alluvium plains, e.g. the Kelantan Plain, give an almost universal response to phosphates and in many cases to nitrogen. This marked response to phosphates could be explained on the basis that the soils are derived from rocks poor in phosphorus, e.g. granite. There is also the fact that Kelantan has not had the advantage of a supply of phosphorus in the form of bat guano which has been available in Kedah.

13. The inland alluvium soils are very variable in their responses. Some of them show quite marked responses to phosphorus and this again is apparently tied up with the parent material of the alluvium.

Chemical Characteristics of Malayan Padi Soils

14. There is great scope for research into reasonably quick and cheap methods whereby soil analyses could be used as indicators of crop requirements for fertilizers. Little or no work has been done on methods of determining available phosphates and potash which take into account the particular waterlogging conditions to which padi soils are subjected.

15. In the Malayan Department of Agriculture extraction with ammonium fluoride and HCl is being used as an extractant for available phosphates. At the present time this is being used as an exploratory device to see what ranges are to be expected. Half-normal acetic acid is being used as an extractant for available potash. It has been noted that the good yielding padi soils are high in exchangeable potash and indeed in bases generally and the poorer yielding areas are lower. This does not mean to say

that all poor yielding areas are low in exchangeable bases or that dressings of potash will increase yields on these soils, but it is a fact that the high yielding areas are generally high. On the other hand dressings of potash have given no general response. The significance of this is now under investigation. Whatever the explanation, the determination of the exchangeable bases would appear to form a useful basis for the prediction of performance of padi soils. Other factors such as pH don't seem to have any tie up.

Methods of Classification for Soil Survey

16. Since the alluvial soils cannot readily be classified by their profile characteristics, some other bases must be sought and the two which have been used are the environment during deposition and the parent material. However, further means of sub-division are needed, and it seems that the only possible ones are textural and, to a lesser extent, chemical, i.e. exchangeable base content. These methods are being used for soil surveys in about a quarter of a million acres of swamp jungle in Perak and in other areas in Selangor where further potential padi areas are being surveyed. This method is laborious and involves the taking of many samples, but it is believed that it will give a fairly accurate assessment of the value of these areas for padi growing.

NITROGEN FIXATION BY BLUE-GREEN ALGAE

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All living things on the earth – animals and plants – must have nitrogen content in their food. The atmosphere contains far more than enough nitrogen to satisfy such requirement. But the free nitrogen in the air is very difficult to be converted into foodstuffs. This difficulty arises from the fact that nitrogen in the air is insoluble in water. However, under high temperature and pressure the atmospheric nitrogen can be transformed into soluble compounds like ammonium sulphate. In nature the atmospheric nitrogen can also be fixed by bolts of lighting to a limited extent. These fixed nitrogenous compounds are absorbed by plant roots so that plants can grow, and these plants are then used by animals as food.

In addition, there are a number of micro-organisms capable of fixing the atmospheric nitrogen. These micro-organisms are divided into two groups: one utilizes, for such fixation, the energy released in respiration and the other makes use of the sunlight energy during the process of photosynthesis. To the former group,

belong several kinds of bacteria, and to the latter a few kinds of photosynthetic bacteria and of blue–green alga.

In this paper the discusssion is limited to the blue–green algae that is known to be able to fix nitrogen in paddy fields for the increase of rice production.

The nitrogen–fixing abilities of the blue–green algae have been reported earlier. The first observation on nitrogen fixation by pureculture of the blue–green algae was made by Drewes in 1928. As the pure culture techniques have been developed, it was found that several species of Nostocaceae could fix the atmospheric nitrogen. Among them the blue–green algae is especially interesting in that it assimilates carbon dioxide and requires light.

The requirements of the blue–green algae for light and water make it particularly important in rice culture as the rice crop has the same requirements.

In 1939 an Indian investigator, P.K. De, found that certain kinds of blue–green alga in rice fields in India were active nitrogen fixers, and concluded that they were probably the main agents in maintaining the soil fertility.

In fact it has long been known that rice fields in tropical regions may remain fertile for a long time without fertilization. From my research work, it has been found that the blue–green algae could increase rice yield as much as 25 per cent. A question could be asked, if there were no such blue–green alga to help to fix nitrogen in rice fields in these tropical areas where no fertilizer is ever used, what would have been the rice yield?

About thirteen years ago, I began collecting blue–green alga from rice fields in various parts of the Far East and South Seas. Of the 643 samples collected, only thirteen species proved to be able to fix atmospheric nitrogen. These thirteen species grew abundantly in such places as Java, Sumatra, Borneo, the Philippine Islands, Malaya, Indo–China, Thailand, Burma, Hainan, Formosa and South China;—but they are scanty in Japan, North China, Manchuria and Korea. They belong to the general Tolypothrix, Nostoc, Schizothrix, Calothrix, Anabaenopsis and Plectonema. From these the following species have been isolated—Tolypothrix tenuis (from Borneo), Calothrix brevissima, Anabaenopsis sp. (from Sumatra), and Nostoc sp. (from Java). The amount of nitrogen fixed in 2 months was 9.6 mgm. for Tolypothrix tenuis; 5.2 mgm. for Calothrix brevissima; 3.4 mgm. for Anabaenopsis sp.; and 3.1 mgm. for Nostoc sp.

The effect of these species on the growth of rice plants was examined in both pot–culture and paddy fields. In pot–culture with Tolypothrix tenuis the leaf length increased on an average by 17 per cent and the number of ears by 30 per cent.

In 1950, I examined the effect of these species on rice yield in nitrogen hungry paddy fields in collaboration with S. Nishigaki and C. Konishi at the National Institute of Agricultural Sciences and regional agricultural experiment stations. One species, Tolypothrix tenuis, grown in a paddy field, released about 20 pounds of nitrogen per acre. The rice yield in a well drained area increased from 44.9 to 51.8

bushels, while in a poorly drained plot where growing conditions were not as good, but the increase in yield was even higher (from 30.3 to 37.8 bushels).

In recent years, field experiments had also been conducted in nitrogen rich rice fields at the various regional agricultural experiment stations in Japan and similar results were obtained. However, the increase in yield in these fields was about 10 per cent on the average, lower than that in nitrogen hungry fields.

Recently the author has been able to produce in his laboratory the species of Tolypothrix tenuis in large quantities for field experiments. After the transplanting of rice, the algal bodies were scattered on the water surface in paddy fields at the rate of 5 kilograms per acre.

As paddy fields in the tropical areas are seldom fertilized and the temperature is high and the field water is usually plentiful, the blue–green algae from Borneo under such conditions would grow vigorously, thus helping to increase the rice yield considerably. This is a new source of nitrogen fertilizer supply worth trying in all rice–growing countries.

RICE BREEDING AND GENETICS BY K. RAMIAH AND M.B.V.N. RAO*

Sir John Russel, when he came to India in 1936 at the invitation of the Indian Council of Agricultural Research, was impressed by the mass of useful data available in the annual reports of the Agricultural Research Stations and in state departmental publications, and he felt that much of the research in agricultural sciences in India was not as widely known as it should be. He suggested in his report that the best way of saving all the good work from passing into oblivion would be the preparation of a critical monograph on each subject by a specialist having a thorough knowledge of the subject. The present monograph on rice is the outcome of this recommendation and it brings together all the available information on rice breeding and genetics in India. While it deals mainly with the work in India, genetical results from outside India have also been included. Considering the fact that rice is the most important food crop of India and one of the three most important food crops of the world and that there has been no comparable compilation available until now, the publication of this book is sure to be welcomed by all interested in rice genetics and breeding.

The field which the book surveys can be considered to cover the ground up to the end of the last decade, and will be welcomed as an authoritative work conveniently correlating a very considerable amount of information. The bibliography contains over 500 references. The monograph is divided into 3 parts. The first one

**I.C.A.R. Scientific Monograph No. 19 (1953), 363 pp., 23 plates. Price Rs. 17/8*

containing 7 chapters deals with the origin and antiquity of rice, its classification, the wildspecies and their affinity to cultivated types, the botany of the rice plant and the studies on developmental problems and breeding techniques. The second part consisting of 4 chapters deals with the application of genetics to the improvement of rice, the methods of selection followed in India, the practical results achieved by breeding and the organization of seed supply. The third part which has 7 chapters summarises all the important work done on the genetics and cytology of the rice plant and its relatives. This is followed by two more chapters, one dealing with the various factors affecting quality in rice and the other with the problem of rice yield in India. There are 4 appendices. The first appendix gives brief descriptions in a tabular form of all the improved strains of rice available in India. The second appendix gives a list of gene symbols recommended for adoption by all rice geneticists. The last two appendices give a glossary of the vernacular names used in the monograph and a laboratory method for determining the cooking value of rice. There are 7 text figures and 23 plates, 10 of which are in colour.

The following is a brief summary of the work outlined in the three parts:

Part I. About 8,000 botanically different rice varieties exist in the world today, of which more than 4,000 have been identified in India. The great diversity of rice varieties also found in the Philippines and Africa would suggest that besides India these areas may be either primary or secondary centers of origin of cultivated rice. All cultivated rice grown in Asia, Europe and America belong to the species *O. sativa*. The cultivated rice in Africa belong to another species *O. glaberrima*. Besides these two, 23 other species are known to occur in a wild state in India, Africa, the Philippines, Java and South and Central America. Many of these species have 24 somatic chromosomes but some have 48.

Two major groups or races are discernible in cultivated rice namely, *O. sativa* forma *indica* belonging to the tropical zones, and *O. sativa* forma *japonica* confined to the sub–tropical and temperate zones. The chromosome numbers in these two races are the same but hybrids between the two show varying degree of sterility, and it is probable that the differentiation in the two races has taken place through the accumulation of gene mutations.

Part II. Rice breeding work which started in India about 40 years ago is discussed under introduction, selection and hybridization. While selection among local varieties has been one of the most fruitful lines of of improving varieties, hybridization has also been practised in some states in India since the early days of breeding. Such hybridization has proved useful and necessary when characters like resistance to diseases, weak straw, tolerance to saline conditions in the soil, etc., were sought to be incorporated in otherwise desirable varieties. While a considerable number of improved varieties has been evolved there still remains the task of breeding varieties suitable to certain special tracts in many of the rice growing states. The importance of seed organization to realise the full benefits of

rice breeding is pointed out, and it has been suggested that the aid of non-official agencies and the cooperatives should be sought in the rapid multiplication and distribution of improved seed.

Part III. This part which contributes to a large section of the monograph is devoted to the genetics of rice, the inheritance of pigmentation, morphological and physiological and quantitative characters, linkage, mutations and cytology, each receiving detailed treatment. The chapters dealing with the inheritance of characters are of importance in that they give an idea of the application of plant breeding and genetical methods to the production of varieties suited to varying needs. The complexity of the phenotypic patterns of several characters in the rice plant makes it imperative that an agreed and uniform method of description and identification of characters and genes is followed by workers in different parts of the world.

Hutchinson and Ramiah standardised the description of rice plant parts in 1938, and Kadam and Ramiah in 1943 proposed a system of gene symbolization. Recently a Japanese worker, Nagao, has suggested certain alterations in the nomenclature suggested by Kadam and Ramiah, and an agreed international system of gene symbolization in rice has yet to be evolved. It may be mentioned that the description of rice plant adopted in the FAO World Catalogue of Rice Genetic Stocks has adopted the information already available on the subject. While a large number of genes have been identified and their modes of inheritance described, the identity of linkage groups has not gone far enough in rice. One major handicap in linkage studies in rice is that the back cross technique cannot be widely used due to the lack of a rapid method of pollination. Artificial induction of mutation in plants through exposure to X-rays and other mutagenic agents has been tried by Ramiah and Parthasarathy as early as 1938. They isolated 36 mutations affecting different characters and 16 chlorophyll deficient types. A complete list of spontaneous and induced mutations recorded in rice are given in a tabular form in the monograph.

The last two chapters deal with quality in rice and the problem of rice yield in India. The factor of quality is discussed in its several aspects. The external appearance of the grain and its nutritive value do not go hand in hand. Since tests for quality are more of a subjective nature, the problem of breeding for quality has not received the attention it deserves. It should however be possible for the breeders in cooperation with the bio-chemist to improve the nutritive value of rice, since varietal variability exists in this character as found out by feeding tests on albino rats and pigeons with grains of different varieties. The problem of yield is dealt under a comparison between rice production in India and other large producing countries, particularly those where high acre yields are obtained, and it is concluded that much can be achieved in India by putting to use the results of research already available. Specail attention is drawn in this connection to the appropriate use of fertilizers as a means of increasing production.

There is no question about the scientific importance of this monograph. It is a valuable source book. To the research worker it should be doubly welcome in that while it enables him quickly to ascertain the existing position, it also makes suggestions as to what remains should be done and the lines along which further work may be pursued. Some of the drawbacks of the publication are the large number of mistakes in printing and the poor set up, though the former has been largely met by a list of errata.

LIST OF PUBLICATIONS PRESENTED TO THE FOURTH SESSION OF THE INTERNATIONAL RICE COMMISSION BY THE GOVERNMENT OF JAPAN

1. **Rice Program in Japan** – by Ministry of Agriculture and Forestry, Government of Japan, Tokyo, 63 pp., October 1954.
2. **Rice Culture in Japan**–by Takane Matsuo, Professor of Tokyo University, 119 pp., October 1954, by Ministry of Agriculture and Forestry, Government of Japan, Tokyo.
3. **Rice and Crops in Its Rotation in Subtropical Zones** – by Eikichi Iso, Japan FAO Association, Tokyo, 611 pp., 1954.
4. **Fertilizer Programs in Japan** – by Ministry of Agriculture and Forestry, Government of Japan, 44 pp., October 1954.
5. **The Chemistry of Paddy Soils in Japan**–by Matsusaburo Shioiri and Takuma Tanada, Ministry of Agriculture and Forestry, Government of Japan, 45 pp., October 1954.
6. **Advance in Investigations of Soil and Fertilizer in Japan** – by Ministry of Agriculture and Forestry, Government of Japan, 86, pp., October 1954.
7. **Inorganic Nutrition, Fertilization and Soil Amelioration for Lowland Rice** – by Shingo Mitsui, Professor of Plant Nutrition and Fertilizer, Tokyo University, 120 pp., 1954.
8. **Fertilizer Industry in Japan** – 55 pp., October 1954.
9. **Agricultural Equipment and Machinery in Japan** – by Ministry of Agriculture and Forestry, Tokyo, 25 pp., October 1954.
10. **Insects and Diseases of Rice Plants in Japan** – by National Institute of Agricultural Sciences, Tokyo, 1954.
11. **Physiological Diseases of Rice Plant in Japan** – by Ministry of Agriculture and Forestry, Government of Japan, 71 pp., October 1954
12. **Carp Culture in Rice Fields as a Side Work of Japanese Farmers** – by Katsuzo Kuronuma, Freshwater Fisheries Research Laboratory, Ministry of Agriculture and Forestry, Tokyo. 27 pp., October 1954.
13. **Nutrition in Japan** – by Public Health and Welfare Ministry, Government of Japan, 11 pp., September 1954.
14. **Vitarice** (Vitamine B_1 Enriched Rice) – Food and Nutrition Association, Tokyo, 5 pp.

15. **Statistical Abstracts for 1954** – by Ministry of Agriculture and Forestry, Government of Japan, 172 pp.

16. **Statistical Compilation on Rice** – by Statistics and Survey Division, Ministry of Agriculture and Forestry, Government of Japan, 150., pp., October 1954.

17. **Outline of Reclamation and Land Improvement in Japan** – by Ministry of Agriculture and Forestry, Government of Japan, 53 pp., October 1954.

18. **Five Years' Record of Rice Competition in Japan** – 65 pp., 1954

19. **Agricultural Research in Japan** – by Research Division, Agricultural Improvement Bureau, Ministry of Agriculture and Forestry, Government of Japan, 13 pp., October 1954.

20. **Extension Work in Japan** – by Extension Division, Agricultural Improvement Bureau, Ministry of Agriculture and Forestry, Tokyo, 46 pp., October 1954.

21. **Present Status of Agricultural Electrification in Japan** – by Agricultural Electrification Association, Tokyo, Japan, 14 pp., October 1954.

22. **Water Resources Utilization System in Japan** – by National Guidance Federation of the Agricultural Cooperative Associations, Tokyo, Japan, 24 pp.

LIST OF ARTICLES PUBLISHED IN THE NEWS LETTER DURING THE YEAR 1954

A limited number of copies of all previous issues of the News Letter are still available. Those interested in obtaining copies should address the Executive Secretary, International Rice Commission, c/o FAO Regional Office, Bangkok, Thailand, indicating the specific number of the issues desired.

Issue No. 9 – March, 1954

1. A Cooperative Program for Rice Improvement in the Philippines, by H.K. Hayes.
2. Rice Production and Improvement in Taiwan, by T.H. Shen and Peter Kung.
3. Outline of Cooperative Rice Breeding and Fertilizer Investigation in the United States, by C. Roy Adair.

Issue No 10 – June, 1954

4. Fertilizer Use for Increased Rice Production, by K. Ramiah.
5. Mechanization for the Small Farmer, by Mason Vaugh.
6. Preliminary Notes on Physiological Diseases of Rice in Malaya, by A. Johnston,
7. Studies on the Blue–Green Algae in Japan, by T. Harada.
8. Spring Paddy in East Pakistan, by A. Alim aud J.L. Sen.

Issue No. 11 – September, 1954

9. The Work of the International Rice Commission – Past and Future, by Ralph W. Phillips.

10. Progress Report of the Work of the International Rice Commission, by C.W. Chang.
11. Report of the International Rice Hybridization Project for the Period, June 1952 to May 1954, by N. Parthasarathy.
12. Rice Culture in Japan, by M. Maruyama.

Issue No. 12 – December, 1954

13. Summary of Recommendations of the Fourth Session of the International Rice Commission held in Tokyo, Japan, 11–19 October 1954.
14. Summary of Recommendations of the Fifth Meeting of the Working Party on Rice Breeding held in Tokyo, Japan, 4–10 October 1954.
15. Summary of Recommendations of the Fourth Meeting of the Working Party on Fertilizers held in Tokyo, Japan, 4–10 October 1954.
16. The Importance of Implements in Rice Production, by Mason Vaugh.
17. Provisional Classification of Padi Soils in Malaya, by J.K. Coulter.
18. Nitrogen Fixation by Blue-Algae, by Atsushi Watanabe.
19. Rice Breeding and Genetics by K. Ramiah and M.B.V.N. Rao – a book review.
20. List of Publications presented to the Fourth Session of the International Rice Commission by the Govenment of Japan.

Printed and Published by Mrs. Prayat Jataputra at Udom Press 395-401 New Road, Bangkok. 2498